

scanning the beam of charged particles across the mask along a predetermined path;

detecting radiation generated by a number of the charged particles incident on at least one mark region provided on the mask, wherein the detecting of the radiation is performed concurrently with the exposing of the radiation sensitive layer; and

controlling the scanning of the beam of charged particles based on the detected radiation.

40. (Previously Presented) The method according to claim 39, wherein the at least one mark region is an elongated mark region extending parallel to a supporting strut of the mask.

41. (Previously Presented) The method according to claim 39, wherein the scanning of the beam of charged particles is controlled such that a deviation between a line along which the cross-section of the beam of charged particles is scanned in the plane of the mask and a predetermined line is minimized.

42. (Previously Presented) The method according to claim 39, wherein the controlling of the scanning of the beam of charged particles comprises stopping the scanning along a predetermined line based on the detected radiation.

REMARKS

Favorable reconsideration of this application is requested in view of the above amendments and the following remarks.

Status of Claims

Claims 1, 3-9, 27-30, and 38-42 are pending in the application. Claim 1 has been amended above to recite a controller responsive to a measuring signal dependent on the number of charged particles detected by the sensor and configured to control the deflector so as to reduce deviations from the predetermined path. Support for this amendment is found, for example, in paragraph 0053 on pp. 13-14 of the specification. In addition, in the embodiment shown in Fig. 4, a sensor 65 detecting charged particles impinging on the mark region, a measuring signal 69 dependent thereon, a controller 58, and a deflector 57 are clearly shown. As explained

at p. 14 of the specification, “the deflection signal generator evaluates the measuring signal 69 and drives the electro-optical component 57 such that the signal 69 is minimized in order for the projection beam cross-section 43 to be positioned on the predetermined path 49.”

Dependent claims 7-9 have been amended for consistency with amended claim 1. No new matter has been added.

Objection to Drawings

The drawings were objected to under 37 C.F.R. § 1.83(a) as failing to show, “the charged particle beam that provides the image on the substrate and the number of the charged particles impinging on the at least one mark region detected by the sensor.” This objection is respectfully traversed.

Fig. 4 shows an electron beam (charged particle beam) 41 that provides an image on a substrate by illumination of a predetermined portion of a membrane layer 37. It is noted that the claimed invention is an improvement on the prior art SCALPEL process, which is described in detail on pp. 2-4 of the specification and shown in detail in prior art Fig. 1. By comparison of Fig. 4 and Fig. 1, it can be seen that the mask 31 of Fig. 4, including membrane layer 37 and struts 33, corresponds to mask 1, including membrane layer 5 and struts 7, in Fig. 1. The projection lens system 15, aperture filter 17, further projection lens system 19, and substrate 3 have not been again reproduced in Fig. 4 to avoid duplication. As clearly shown in Figs. 2-4, when the electron beam 41 is perfectly aligned with the predetermined path 49, no electrons of the projection beam 41 impinge on the struts 43. If, however, the projection beam deviates from the predetermined path as illustrated in Fig. 1 by beam 41¹, impingement on mark layer 61 causes characteristic X-ray radiation 63, which is detected by sensor 65. *See* specification, ¶ 0053. Accordingly, it is respectfully submitted that all claim limitations are shown in the figures, and thus withdrawal of this objection is requested.

Rejection Under 35 U.S.C. § 112, 1st paragraph

Claims 1, 3-9, 27-30, and 38-42 stand rejected under 35 U.S.C. ¶ 112, 1st paragraph, as failing to comply with the written description requirement. Specifically, the Examiner argues, “the specification is completely silent for reciting the limitations ‘a sensor for detecting,

concurrently with the imaging of the pattern of the mask onto the substrate, a number of the charged particles impinging on the at least one mark region provided on the mask' as recited in claims 1, 4, 28 and 39." This rejection is respectfully traversed.

This rejection under ¶ 112, 1st paragraph is closely related to the objection to the drawings discussed above and is considered untenable for the same reasons. Specifically, the specification explains in great detail how the projection beam 41 is applied to the mask so as to image the pattern of the mask onto the substrate. *See, e.g.,* ¶ 0049, which explains how the projection beam moves across the mask 31. *See also* ¶ 0027, which explains, "the invention proceeds from a projection apparatus for imaging the pattern of the mask onto a substrate comprising a radiation sensitive layer by means of a beam of charged particles, said projection apparatus including a beam shaping means for producing the projection beam with a predetermined projection beam cross-section in the mask plane as well as a positioning device for moving the projection beam cross-section in the mask plane over the mask along a predetermined path parallel to a direction into which the struts extend."

Paragraph 0028 of the specification explains the difference between the scattering caused by the specific mark regions and the scattering caused by the pattern-forming material on the mask:

Said different interaction with the charged particles which is characteristic of the mark material is detectable by a suitable sensor so that the sensor provides a measuring signal that is dependent on the number of charged particles which impinge on the mark region.

Thus, the fact that electron beam 41 serves to image the pattern of the mask onto the substrate should be very clear. In addition, the specification discloses not just one but in fact several embodiments illustrating how a number of charged particles impinging on at least one mark region during the imaging may be detected to provide guidance for the projection beam along the predetermined path of the mask. A sensor 65, and the charged particles 63 impinging on mark region 61, are clearly shown in Fig. 4 and are described in detail in the specification including, *inter alia*, ¶ 0053.

In response to the Examiner's question, "How is the image of the charged particle beam corrected," Applicant respectfully notes it is the *location* of the projection beam with

respect to the mask that is adjusted (or corrected) based upon the number of charged particles impinging on the mark. This is explained in the specification at, *inter alia*, ¶ 0052.

In view of the above, withdrawal of this rejection is respectfully requested.

Rejection Under 35 U.S.C. § 102(a)

Claims 1, 3, 7-9, 27, and 38-42 stand rejected under 35 U.S.C. § 102(a) as being anticipated by Yahiro et al. ("Yahiro"). This rejection is respectfully traversed.

The Examiner states that Applicant's arguments filed on September 13, 2004, "have been fully considered but they are not persuasive in view of the foregoing reasons." However, in support of the rejection under 35 U.S.C. § 102(a) over Yahiro, the full extent of the Examiner's explanation is, "See the reasons as indicated in the previous office action dated December 16, 2003." Obviously, those reasons predate Applicant's arguments submitted on September 13, 2004, and thus, *a fortiori*, cannot be responsive to either Applicant's arguments or to the claim amendments presented with the September 13, 2004, response. Applicant's detailed arguments presented in traversal of this rejection under § 102(a) as presented on pp. 8-11 of the September 13, 2004, response are hereby incorporated by reference. To summarize those arguments briefly, Yahiro discloses a pre-scan method of determination of mask distortion prior to imaging of the mask's pattern. Yahiro is completely silent as to the claimed sensor for detecting charged particles impinging on at least one mark region concurrently with the imaging of the pattern of the mask onto the substrate. Because each claim limitation must be shown in a single prior art reference to maintain a rejection under 35 U.S.C. § 102, this rejection is improper and must be withdrawn.

Moreover, in the interest of expediting prosecution, claim 1 has been amended as explained above to further specify, "a controller responsive to a measuring signal dependent on the number of charged particles detected by the sensor and configured to control the deflector so as to reduce deviations from the predetermined path." Support for this amendment is set forth above. The controller 58 is clearly shown in Fig. 4 as being responsive to the sensor 65 and as controlling the deflector 57. Even if one were to consider, *arguendo*, that Yahiro's pre-imaging, pre-scanning process to be similar to the concurrent process of the claimed invention (a contention with which Applicant vehemently disagrees), Yahiro is plainly devoid of any

disclosure or suggestion of a controller as claimed. Accordingly, for this reason in addition, withdrawal of this rejection under § 102 is respectfully requested.

Allowable Claims

Applicant thanks the Examiner for again indicating the allowability of claims 4-6 and 28-30. Claims 4 and 28 were rewritten in independent form in the previous response, and thus should now be allowable. Claims 5-6 and 30 depend from claim 4, and thus should also be allowable. Claim 29 remains dependent from claim 3, which in turn depends from claim 1 discussed above.

Information Disclosure Statements

Applicant has filed three Information Disclosure Statements to date:

(1) IDS No. I

The first IDS was filed December 11, 2001, and was received at the USPTO January 16, 2002. The Form PTO-1449 was initialed and returned to the Applicant with the Office Action mailed December 16, 2003. However, Reference A12 was lined through and not considered, with the notation, "This is not the prior art." Because the ESRF Annual Report for 1995-1996 is indeed believed to be prior art, Applicant resubmits that reference herewith and respectfully requests consideration thereof. For the Examiner's convenience, a new Form PTO-1449 listing only the ESRF reference is enclosed at Tab A. However, Applicant respectfully notes that this reference was originally and properly cited prior to a first office action on the merits.

(2) IDS No. II

A second Information Disclosure Statement was filed March 25, 2003, and was received at the USPTO April 1, 2003. Although at page 4 of the most recent action the Examiner acknowledges receipt of this Information Disclosure Statement, the initialed Form PTO-1449 has still not been received by Applicant. A copy of the initialed Form PTO-1449 is requested with

the next Action. For the Examiner's convenience, a copy of the April 1, 2003, Information Disclosure Statement is attached hereto at Tab B.

(3) IDS No. III

A third Information Disclosure Statement was filed January 13, 2004, and was received by the U.S. PTO January 16, 2004. The Examiner acknowledges receipt of that Information Disclosure Statement at page 4 of the most recent action. However, on the copy of the Form PTO-1449 enclosed with the action, References A3, A4, and A5 have been lined through and indicated as "Not received." This is curious because, not only were these references originally submitted with the Information Disclosure Statement, pursuant to the Examiner's request during the interview of July 29, 2004, these references were submitted for a second time with the response filed September 13, 2004. Nonetheless, in a sincere effort to ensure all submitted prior art has been considered by the Examiner, Applicant submits herewith duplicate copies of References A3, A4 and A5, together with a clean Form PTO-1449 listing these three references (see Tab C).

In view of the above, return of the initialed Form PTO-1449 associated with IDS No. II and return of the Form PTO-1449 indicating consideration of References A3-A5 submitted in IDS No. III are respectfully requested.

Request for Interview

In light of the lengthy proceedings in this case, and in the interest of expediting prosecution, should the Examiner for any reason, after consideration of this Response, find the application not to be in condition for allowance, the Examiner is respectfully requested to contact the undersigned so that an in-person interview may be scheduled. The Examiner's kind attention to this matter is greatly appreciated.

Because the formal matters have been attended to, and the claims have been shown to be allowable over the prior art, the application is in condition for allowance. A favorable action in the form of a Notice of Allowance is earnestly solicited.

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Respectfully submitted,

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Attachments